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### Artificial Womb Technology: A Roadmap to a changing Medico-Legal Landscape

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#### KEYWORDS

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In-vitro fertilization

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#### ABSTRACT

Scientists worldwide have tried to replicate birth processes for years, which have resulted in many new infertility solutions like in vitro fertilization (IVF) or surrogacy, but Artificial Womb Technology (AWT) is the most advanced and unique. AWT proposes an alternative to conventional pregnancy and childbirth. Presently, there is no prototype of an artificial womb for people. The innovation is particularly in its early stages. However, we do have to think about the scientific moral, and legal issues before racing into this innovation. We also need to deal with social, religious economic, and health issues. Here in this paper, we have specifically done a critical analysis of the bioethical issues concerning this upcoming technology. A transdisciplinary approach encompassing both the legal and scientific viewpoints, concerns, and suggestions related to this new technology has been discussed. We strongly suggest a worldwide discussion and be ready with a strong framework before we practice AWT, a venture whose outcomes are yet awaited.

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## 1 Introduction

Innovation that can support the artificial growth of human fetus will change the most significant and changeless notion of human multiplication that has been there since forever: that a baby should gestate in a woman's body' (Jennifer 2006). Two groups of researchers from Australia, Japan, and the United States got some optimistic outcomes from examining organism development in artificial womb models, pulling in huge media consideration, in 2017 and 2019 (Partridge et al. 2017; Usuda et al. 2019), also, more as of late a third exploration group situated in the Netherlands declared that they had gotten a considerable fund to build up an AW prototype (Davis 2019). The progressing efforts of these researchers (Table 1) and clinical specialists are gaining significant headway towards improving an AW tool that can mimic the cycle of normal pregnancy in ectogenesis.

### 1.1 History

Chronologically, the recorded data finds the mention of Ectogenesis in the early twentieth century. At that time, it found alchemists like Paracelsus writing about Ectogenesis as future technological development (Hedesan 2014). Despite so, we can find references to Ectogenesis through various mythologies around the world. It is beyond doubt that Hindu mythological scriptures and even Epics are storehouses of unexplained references in biology and technology.

One such that seems quite relevant is a direct reference from the Epic – 'Mahabharata'. The storyline depicted one royal queen named Gandhari, unable to deliver a baby, falling victim to miscarriage. Then Saint Veda Vyasa who was her father-in-law put

the parts of the disintegrated embryo into jars, which later became the "Kaurava Princes" (Kalra et al. 2016).

Christopher Kaczor categorized Ectogenesis into "partial ectogenesis" and "complete ectogenesis". The former deals with some part of the gestation outside the natural womb, whereas the latter involves complete incubation in an artificial womb. These divisions have been monumental in categorizing further research into the subject (Kaczor 2010).

In 1932, Aldous Huxley presented a dystopia having a concept of the artificial womb (AW) in his science fiction novel "Brave New World" (Huxley 1932). Emanuel M. Greenberg, a New York doctor and inventor developed a design for an artificial womb and filed a patent for the same in 1955 (Greenberg 1955). Dr. Yoshinori Kuwabara, a researcher from Juntendo University in Japan, published his work on partial Ectogenesis. His research involved gestating a goat embryo outside the maternal womb in an artificial environment made out of a plastic container containing solution mimicking amniotic fluid (Kuwabara et al. 1989).

In 2001, Hung C L from Cornell University crafted an artificial uterus by using biodegradable scaffolding, and in vitro cultured human endometrium cells. She grew a surplus human embryo obtained from fertility banks for about six days before the experiment was terminated (Liu et al. 2001). While there has been little development in the field, it is also fixed with skepticism from researchers. An eminent fertility specialist in California, David Adamson accepts that AWs are still many years away from being clinically possible because of immunological and cardiovascular issues (Rosen 2003).

Table 1 Timeline of the developments in Artificial Womb Technology

Year	Development in AWT	Reference
Earlier 20 <sup>th</sup> century	Paracelsus Wrote about Ectogenesis as future technological development.	Hedesan 2014
1932	Aldous Huxley Presented a story version of the artificial womb in his novel "Brave New World".	Huxley 1932
1955	Emanuel M. Greenberg, a New York doctor and inventor, created a design for artificial womb and filed patent for this.	Greenberg 1955
1989	Yoshinori kuwabara and his group from Japan were able to gestate a goat embryo in an artificial environment made up of plastic container having solutions mimicking the amniotic fluid.	Kuwabara et al. 1989
2001	H C Liu of Cornell University crafted an artificial uterus using biodegradable scaffolding, and in vitro cultured human endometrium cells.	Liu et al. 2001
2015	Miura and his group developed an "ex-vivo uterine environment (EVE)" therapy utilizing an artificial placenta for providing nutrients and gas exchange to developing lamb.	Miura et al. 2015
2017	Partridge and his group from USA were able to provide physiological support to extremely premature lamb for up to 4 weeks	Partridge et al. 2017
2017	Dr. Flake, presently a foetal surgeon at a Children's Hospital in Philadelphia received the "Scientist of the Year Philly Geek Awards" for delivering premature lambs in "Bio bags".	Tom 2017
2020	Dr. Guid from MMC, Netherlands, proposed to develop a protocol for an artificial womb within 5 to 10 years after receiving a new €2.9 million grant from the EU program "Horizon 2020" for researchers in Eindhoven.	TU/e 2020

In 2017, Dr. Flake, presently a fetal surgeon at a Children's Hospital of Philadelphia received the "Scientist of the Year Philly Geek Awards" for delivering premature lambs in "Bio bags". These were fluid-filled AWs that mimicked the mother's womb to quite a realistic level (Tom 2017). A subsequent research group in Australia devised an elective plan named the "EVE (ex-vivo uterine environment) platform' for extended survival of a fetus in an artificial environment (Usuda et al. 2019).

## 2 Project Artificial Womb on Human Beings

The development of human beings through artificial means outside the mother's womb is controversial, particularly when we are not sure of justified advantages. The U.S. Office for Health and Human Services, British Medical Research Council, and The World Medical Association, in any case, all acknowledge that non-therapeutic exploration in such conditions may be legitimate as it can save the life of a premature baby or in conditions where a mother is medically unable to continue the gestation.

Brazier and Alghrani reason that the capability of the artificial womb to "improve the care of premature babies provides a strong case for permitting ethically approved research". Subsequently, the AWT trial can be defended, albeit the truth, as indicated by Brazier and Alghrani, is that investigation into Ectogenesis being in any underlying concern's general benefits is debatable. The utilitarian significance of advocating the use of artificial womb technology is that in such cases the research includes the prementioned convention, strong examination plan, defined protocol, and systems intended to guarantee the assurance of subjects and to guarantee the creation of generalizable information. The research should be allowed in case of clinical premature birth (Alghrani and Brazier 2011). Administrative offices, like FDA (Food and Drug Administration) in the US or the TGA (Therapeutic Goods Administration) in Australia would necessitate broad clinical proof before these devices could be used for ectogenesis. FDA has a risk-based device classification based on the safety and efficiency of a medical device. Class I, II, and III devices represent low to moderate risk, moderate to high risk, and high risk, respectively. AWT is probably going to fall in class II/ III. The FDA has the power to require that gadgets of high-risk category settle pre-market endorsement. So they can't be by, and large utilized before clinical examinations have exhibited their wellbeing and viability. Studies with the prospective for significant danger should be supported by an Institutional Review Board (I.R.B.) and the F.D.A. Comparable progressive characterization frameworks, with measures requiring broad proof for medical devices to access high risk to patients, have been set up in Australia and Europe (Romanis 2020a). There are two classifications for the use of Artificial Womb for ectogenesis i.e. (a) ex vivo pregnancies or Complete ectogenesis: the embryo is managed with IVF strategies and it is straightforwardly embedded into the artificial womb for the whole

incubation; and (b) ex utero pregnancies or partial ectogenesis: the embryo begins the natural pregnancy in the womb of a mother and later it is implanted into an artificial womb for the remainder of the development.

In the Eindhoven University of Technology (Netherlands), Scientists have got a Future and Emerging Technologies fund from the European Union Program, "Horizon 2020" of just about 2.9 million Euro to develop a protocol for an artificial womb within 5-10 years. The replica, which is being created, would incubate babies with artificial conditions for development and breathing (Davis 2019). Outstandingly, if there should be an occurrence of untimely parturition, the artificial womb will be a sufficient replacement for the unfavorable conditions of the mother's uterus. It will give an indigenous habitat to the infant so that it faces the least disturbances due to the transition from a natural womb to an artificial environment. In contrast to existing incubators, the Awws would be like a natural ambiance. Fluids, oxygen, and supplements would surround the child within the artificial placenta and will interface with the umbilical cord. Premature birth has been a significant issue, influencing more than 1 out of 10 children worldwide. Prematurely born children might have more medical conditions or require remaining in NICUs (Neonatal Intensive Care Units), which help in supporting their cardiorespiratory capacity and advancement to the entire period of gestation. Despite development in medication for premature babies, NICUs are not a very good standby for the safe and protective environment of the mother's womb (Brado et al. 2021).

An artificial womb may be a better alternative to an incubator and artificial respiration owing to its close resemblance with the natural womb. Guid Oei, a renowned gynecologist at Maxima Medical Center(Netherlands), said "Using this artificial womb, we want to help extremely premature babies through the critical period of 24 to 28 weeks,"

"Over the next eight years, we're going to develop these technologies, and come up with the first prototypes of the artificial womb. Once these have been carefully tested, we want to help the first extremely premature baby in our artificial mother in eight years' time in the first clinical tests. That's quite the challenge," says Oei. (TU/e 2020)

## 3 Ethical Issues

One cannot pick a side in the battle of ethics when it comes to a matter such as Ectogenesis. It could be beneficial in saving the lives of premature babies, helping in fecund couples, giving gay and transgender people new procreation alternatives, and aged parents to experience parenthood. AWT could provide a substitute for conventional pregnancy and childbirth. The fetus could avail a healthier environment free from drugs and alcohol contamination

supplemented with an absolute equilibrium of nutrients, sound, temperature, and movement. AWT will also help to balance gender inequalities.

Smajdor, a supporter of ectogenesis, argues that “the fact that women have to gestate and give birth to have children, whereas men do not, is a prima facie injustice that should be addressed by the development of ectogenesis” (Smajdor 2007, 2012)

On the other hand, we find experts such as Dr. Randy Morris of the University of Illinois, School of Medicine, and Dr. Foreman, (Bioethics Group, David Geffen School of Medicine at UCLA) inquiring about the capability of AWT to recreate the complicated technique at service throughout the regular pregnancy. Their main doubt is regarding the AWT's capacity to perpetuate the amount of blood flow needed to sustain a child during pregnancy (LaFee 2004). Dr. Nobuya of the Kuwabara research group also acknowledges the concern raised due to challenges faced by the technology. The amount of extracorporeal blood needed to endure one extrauterine gestation would be excessively costly (David 2010).

### 3.1 The Morality of Artificial Womb Technology

Though Ectogenesis showers some magnificent opportunities to the couple who cannot conceive, it ethically violates the natural law of birth. Ethically and according to the natural law of birth, a baby is meant to be born in a mother's womb and whenever this baby delivering method is manipulated by human intervention, and then it becomes unethical. So, if such a technique is not considered to be ethically correct, then what will be the future of the "Artificial Womb" technique in society or the world at large? This question remains unanswered till the ethical boards of society agree.

### 3.2 Religious Issues

Technology has not always been accepted with open arms. There is always friction from the orthodox part of society. From Galileo's derivation of the sun being in the center to Ectogenesis, all questions religious teachings and beliefs, leading to social aggression upholding the moral permissibility of such scientific developments. Even though the official and authoritative teaching of the Catholic Church has not yet given a conclusive pronouncement on the official authority of AWT. "Donum Vitae" (Roman Catholic published “Instruction on Respect for Human Life in its Origin and on the Dignity of Procreation”) addresses it straightly. It says, “*These procedures are contrary to the human dignity proper to the embryo, and at the same time they are contrary to the right of every person to be conceived and to be born within marriage and from marriage*” (Donum vitae 1987). The maternal instincts are put into question when a woman opts for

such a procedure to preserve her physical appearance and limitations on food and alcohol consumption and to elude the physical problems in the ordeal of pregnancy and childbirth.

Secular bioethicist, Deane Wells and his collaborator Peter Singer, famously write "*freedom to choose what is to happen to one's body is one thing; freedom to insist on death of a being that is capable of living outside one's body is another*" (Shook and Gelfand 2006).

The greatest challenge to the Church's and other religious beliefs would be when homosexual men could use the technology to 'procreate' without the need of the opposite sex to serve as a surrogate where male-derived embryonic stem cells could be used to develop female oocytes (Rosen 2003).

This could be the gateway to someday creating a fetus out of the genetic elements of both homosexual couples. With the growing acceptance of the LGBTQ community worldwide, AWT will be helpful to cater to their procreation requirements.

### 3.3 Social Issues

AWT infringes women's "right to choose" in many ways. It should be a mother's choice whether to remove an embryo developing in her womb in case of any unavoidable medical emergency. If a developing embryo or a fetus is not operable and the mother wants it to be removed out of her womb, it's her choice. The worst-case scenario would find women being forced to have their fetuses withdrawn and gestated out of their bodies. This could be a serious issue in countries where a conservative mindset dominates society. There is universal concurrence that artificial womb technology is appreciated both to support preterm and to diminish others of the loads leaned merely on them for giving birth to offspring. AWTs could reduce the loads set only on ladies in multiplication, because the innovation may decrease the requirement for pregnancy.

We live in a society where an invention comes with many criticisms before it gets approved on a large scale. So, an "artificial womb" technology is not an exception to that. It will also have to be approved by society for complete success.

### 3.4 Economic Perspectives

If such a procedure gets to be funded by private business organizations, then the people at the helm of these organizations would be quite the authority to conclude how, when and for whose advantage it should be put to use. In the bounds of state, private insurance companies, this could be an escape from covering the unpredictable cost of traditional childbirth. This could create a divide in a society where AWT would be the flag bearer of the privileged class and conventional pregnancies related to those who cannot afford it. Some crucial points to be noted in this regard are (i) Considering the cost incurred in AWT, it is presumed that such

a technology will be only helpful for rich people urging for parenthood, (ii) Another crucial point is that if the machine goes wrong and the procedure does not execute positively, who will be responsible for such a loss? Will it be the doctors, institution, or the prospective parents who will bear the cost?, (iii) Considering that even if the doctors and/or organizations are held responsible, will they compensate and give it another try for their mistake? There is the least probability for such compensation, and (iv) Moreover, if we blame the machine (the artificial womb) for the loss, it does not matter as a machine is nothing but a non-living object operated by humans. So, in this technique, we are simply leaving the fate of a living being to a non-living object.

### 3.5 Global Perspectives

Artificial womb technology is not quite the global talk even though it has a multitude of implications. When the technology is commercialized, it is bound to create a rift between those nations that can afford it and allow it to be practiced within their jurisdiction and those that cannot. It will tend to give an air of authority to those with the affordability of such technology.

Moreover, AWT also tends to boost the economy for those countries that have lenient regulations regarding such advancement. Countries like India and Israel have favored destinations for fertility tourism where assisted reproductive technology is becoming an increasing source of income. Medical tourism is an untapped resource and outsourcing that can be a massive backbone in developing stunted economies (Salama et al. 2018)

AWT can be the holy grail to countries that regulate reproduction to control the population. A higher population density means lesser resources and a backward economy. Countries having an unbalanced gender ratio may use such technology to manipulate the male-female ratio. Other than that, AWT can be the gateway to designer babies. Genetic manipulations can help remove defective genes that can cause genetic disorders in the future. AWT will not only shift the present perceptions of society regarding women but also elevate them to a certain extent (Bulletti et al. 2011).

### 3.6 Mother Is More Than a Uterus

Recent studies have shown that a mother's mental state directly or indirectly influences the fetus—a mother's posture, rest cycle, diet, and voice, all influence the baby. According to Janet Dipietre, a researcher at the John Hopkins Fetal Development Project, "*the maternal context provides an environment that goes far beyond the direct circulatory system connection*" (Don 2015).

Janet Di Pietro, in his study, reports that It can be good for the fetus to be under moderate levels of stress. Janet and Baltimore reports that light anxiety or stress in an otherwise healthy and stable pregnancy could activate the nervous system to mature more

speedily, and could stimulate cognitive and motor development in a developing embryo (Sandman and Davis 2012; Viltart and Vanbesien-Maillot 2007; Buss et al. 2012)

Sensory and neuronal mechanisms of the brain for hearing develop by the 30th week of pregnancy, and a study shows that babies while being in the mothers' womb can hear their mothers speak during the last 10 weeks of pregnancy and convey, maybe, in their own way, what they heard after their birth (Moon et al. 2013). As an embryo develops, it is continually attaining information from its mother. It isn't simply hearing her pulse or any other music she may play, but the emotional and social behavior of the mother may also feed signals through her placenta. "*We believe that the human fetus is an active participant in its own development and is collecting information for life after birth,*" (Sandman et al. 2012)

During the Dutch Famine in the year 1944, starving mothers giving birth during that time found their babies huddled with problems like obesity or diabetes. Researchers of the University of California- Irvine established the fact that a growing fetus demanded consistency in the mother's health pre and post-birth. Mothers remaining healthy/unhealthy both before and after birth showed no change in the development of the fetus. Whereas mothers who became healthy from being depressed after birth seemed to be down the pace of the child's development (Guller et al. 1984).

All of this comes down to one very simple question, "Does the limits of human science permit the replication of something as complex as the Uterus?"

Since 1982 when the first experiments of implantations (Bulletti et al. 1986) outside the human body began, the maintenance of an extracorporeal profusion led to sustain ex-vivo human uteri have been followed (Bulletti et al. 1988a). Yet the complications remain the same. When in 1989 it faced a judgmental panel of political groups that upheld the banner of Ethical issues, the experiments being conducted in Italy came to a sudden halt. One among its significant challengers were the opinions voiced against it in the journal "Fertility and Sterility" (Bulletti et al. 1988b). Before AWT becomes a reality, this article needs to address some major issues like:

- i. Human placenta and the possibilities of its replication. Connecting a human placenta to an artificial womb in cases where the fetus has been removed from the womb after conception (Callaghan et al.1963).
- ii. Uterine transplantation and immune rejection.
- iii. Artificial suppliers and disposers being apt replacers of natural ones when the fetus is developed in a separate environment.



- iv. The various kinds of psychological and physiological build up the fetus undergoes in the complete absence of a maternal host when in an artificial environment (no influence of maternal mental state and alcohol or tobacco intake).
- v. Next in line is the capacity of the process of dialysis in waste disposal. What effect can it have on the mainstream purification capacity of the infant's body post-birth when it might be possible that the fetus learns to purify its own blood completely out of imitation of the mother's purification process (Completely Hypothetical) (Bulletti et al. 1997). ECMO (Extracorporeal Membrane regeneration) and its capacity to oxygenate blood is validated but only in the case of a goat fetus. So, what are the complete guarantees this process can provide for a human fetus without future effects (Alexander et al. 1968).

#### 4 The legalities of choosing ex utero development: Indian Perspective

The innovative advancement should be pointed towards giving advancement to individuals' life. According to Dr. Flake, the objective of AWT research is to provide "physiologic help" by mimicking the environment in the uterus as intently as could be expected, keeping more untimely infants to survive and creating better security for them. Dr. Flake further added that one cannot compare a child developed in an artificial womb with the sound fetus in the mother's womb, but rather one can compare it with the extremely premature infant born and continued with the help of existing incubator technology, which often leads to life-threatening complications. However, he further pointed out that there may be some other complications also in such infants. He is concerned that the benefits of the technology may be overshadowed by the harm it poses (Yuko 2017).

Legally it is important to contemplate the protections accessible for authorities furnishing the end of pregnancy to proceed with development ex utero. Finishing the pregnancy is viewed if all else fails because N.I.C. is no assurance that an immature baby will survive (Romanis 2020b).

"The Medical Termination of Pregnancy Act, 1971" ("MTP Act" hereinafter) in India prescribes grounds under which termination of pregnancy is possible. According to the "Medical Termination of Pregnancy Act, 1971" the decision to terminate a pregnancy and convey embryo preterm should only be explored when (MTP Act 1971);

- (i) the pregnant woman would face grave mental or physical harm in case of a continued pregnancy; or
- (ii) in case the child is allowed to be born, it is highly expected to have severe mental and/or physical abnormalities.

#### 4.1 "The Medical Termination of Pregnancy (Amendment) Act, 2021"

In India, if a pregnancy is terminated medically within 12 weeks after conception, one doctor's opinion is required, while two doctors' opinions are required if the pregnancy is terminated between 12 and 20 weeks. "The Medical Termination of Pregnancy (Amendment) Act", which may pave the way for AWT, enables abortion on the advice of one doctor up to 20 weeks, and two doctors in the case of certain groups of women between 20 and 24 weeks. This Act also establishes state-level Medical Boards to decide whether a pregnancy can be aborted after 24 weeks if there are significant foetal abnormalities (Medical Termination of Pregnancy (Amendment) ACT 2021)

#### 4.2 Right to life vs Right to choice

Across the world, there is an ongoing debate on right to life and the right to choice. Depending on the foetal health and risk to the pregnant woman, different countries have different rules and time limits for allowing abortions. On one hand, choosing to end a pregnancy is a choice that is part of a pregnant woman's reproductive rights and on the other hand, the state also should protect life and should provide for the protection of the fetus. To strike a balance between these two rights is very important and the decision should be taken very carefully. In these situations, the AWT can be of great help to protect the rights of both the mother and the child. Both may survive by following this technology.

The Indian Penal Code also has provisions regarding causing of miscarriage, of injuries to unborn children, of the exposure of infants, and of the concealment of births, starting from Section 312-318 (Indian Penal Code 1860). Even a pregnant lady can be held liable in certain cases if she causes herself to miscarry without following the law. The Constitution of India under Article 21 provides and protects the cherished Right to life (The Constitution of India as on 9<sup>th</sup> December 2020)

#### 4.3 "The pre-natal diagnostic techniques (regulation and prevention of misuse) amendment act, 2002"

In India, female foeticide is rampant. The "Pre-Natal Diagnostic Techniques (Regulation and Prevention of Misuse) Amendment Act, 2002" provides for (a) Sex determination after or before conception, (b) Regulations of prenatal diagnostics to determine sex-linked disorders, congenital abnormalities, metabolic disorders, chromosomal abnormalities, and inborn errors of metabolism, and (c) preventing female foeticide due to misuse of sex determination

The prime feature of this Act is to safeguard the girl child from female foeticide (Patnaik and Kejriwal 2012). In the case of ectogenesis, we are uncertain as to how far it will be possible to

keep the sex of the child a secret to their parents. This warrants the need of a regulated system to be developed to restrict any type of manipulation or identification of the gender of the baby developing ex-utero (“The pre-natal diagnostic techniques (regulation and prevention of misuse) amendment act 2002”)

#### **4.4 “The Assisted Reproductive Technology Act, 2021”: Future Roadmap**

Section 2 (1)(a) of this Act defines “Assisted reproductive technology” with its grammatical variations and cognate expressions, means, “all techniques that attempt to obtain a pregnancy by handling the sperm or the oocyte outside the human body and transferring the gamete or the embryo into the reproductive system of a woman.”

The “Assisted Reproductive Technology (Regulation) Act 2021” also has provisions to establish State Boards, National Board, and National Registry of Assisted Reproductive Technology (ART) in India to accredit and supervise ART Banks and ART clinics. The objective of this is to ensure the ethical nature of these services provided and to protect all the rights of all persons (including surrogates) while providing the maximum benefit to all stakeholders within a recognized framework of ethics and good medical practices. Offences under the Act (“The Assisted Reproductive Technology (Regulation) Act 2021”) states: “Any medical geneticist, gynecologist, registered medical practitioner or any person shall not (a) abandon, disown or exploit or cause to be abandoned, disowned or exploited in any form the child or children born through assisted reproductive technology; (b) sell human embryos or gametes, run an agency, a racket or an organisation for selling, purchasing or trading in human embryos or gametes; (c) import or help in getting imported in whatsoever manner, the human embryos or human gametes; (d) exploit the commissioning couple, woman or the gamete donor in any form; (e) transfer the human embryo into a male person or an animal; (f) sell any human embryo or gamete for research; or (g) use any intermediates to obtain gamete donors or purchase gamete donors”.

The proposed offenses will be penalized with fines ranging from five to ten lakh rupees for the first contravention. In cases of subsequent contraventions, punishment will range between imprisonment for three to eight years, and fines between 10 to 20 lakh rupees. Any clinic or bank that advertises or offers sex-selective Assisted Reproductive Technology will face a sentence of five to ten years in prison, a fine of Rs 10 lakh to Rs 25 lakh, or both.

It’s high time to start thinking about some of the ethico-legal issues related to trial AWT before they are viewed as a clinical alternative. Vocalist and Wells contended in 1984 that the capacity of current medication to guarantee the endurance of preterms

implied that Ectogenesis was at that point an incomplete reality. Both Cannold and Alghrani allude to partial Ectogenesis as a reality shown by the ‘development of premature children in incubators’ (Horn and Romanis 2020). Subsidiary legal issues like experimenting with human embryos have stunted development in the sector for the past few years. In a highly populous country like India where there is a strong democratic framework with multiple views, the acceptance of something new is challenging. It has been almost over a few decades since in-vitro, surrogacy, and many such technologies have emerged and accepted by society. Laws should be put up where Ectogenesis will become a procedure only open to legally proven necessities.

#### **5 Probable Misuse of Awt**

In the wrong hands, this technological development may be lethal. The probable misuses of AWT may be:

##### **5.1 Human Trafficking**

Globally, the commodification of human beings has transcended below the lowest of standards. Human Traffickers have set up a black market where human beings are bought and sold like commodities for various purposes. By using AWT these criminals may misuse it for satisfying illegal purposes.

##### **5.2 Genetic modifications to make a designer baby**

Opening a myriad of options, starting from choosing what genes to keep and what not. Babies born in an artificial womb would surely be free of certain genetic discrepancies and might be completely different from their biological parents.

##### **5.3 Cheap labor**

Humans could be grown as a crop through AWT and put to labor. There may be ownership over an individual born artificially, and slavery may get a new dimension.

##### **5.4 Organ harvesting**

Ectogenesis would be a boon to such miscreants. Developing a fetus just to harvest its organs would cause an increase in crime and destroy and devalue the life of a human being.

##### **5.5 Human lab rats for scientific experiments**

In a world where it is even inhuman to use animals for scientific experiments, how can we even consider humans. Whereas considering that Ectogenesis may provide the opportunity to artificially conceive babies, a single individual can produce babies like a crop with all legal rights upon them as guardian subjecting them to lab experiments. There is also a hypothetical scenario where artificially grown humans could be subjected to colonization

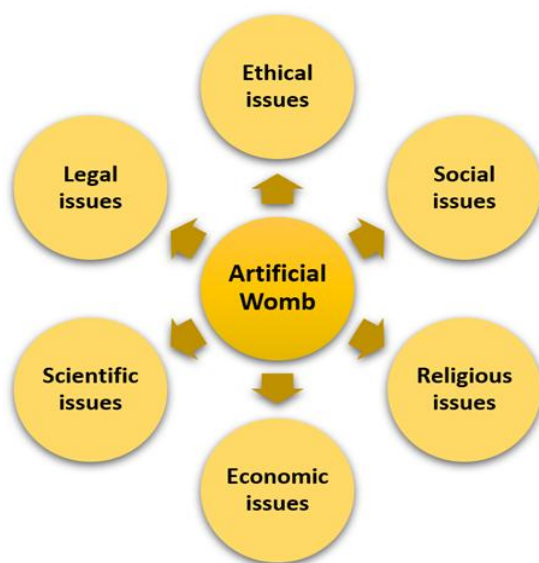


Figure 1 Bioethical and other issues related to artificial womb technology. The diagram highlights six significant issues which have been raised in the future implementation of artificial womb.

experiments on other planets giving them a very less percentage of survival and more chances of a horrific existence and finally death.

### Conclusion

Artificial womb is a genuine and significant innovation and something deserving a moral discussion. In such a scenario, the need for rules emerges. Embracing ethical pluralism, the law will be held responsible for encouraging or restraining scientific technology. Significantly, the innovative advancement is pointed towards giving an improvement to individuals' life.

However, even before it becomes a reality it has initiated debates on many related issues (figure 1) and has raised concerns over its probable misuses (figure 2). It is additionally critical to consider every part of the issues including philosophical, clinical, bioethical ones, likewise the advantages and disadvantages of it. Presently, there is no prototype of an artificial womb for humans. The innovation is very much in its early stage. But we require to be prepared for our upcoming developments in the following decades.

When something so complex like Ectogenesis demands a green light, ethical and legal issues are bound to arise. We need to work out the critical scientific studies that have brought up loopholes in its mechanism. By the depiction, it is a high-level life supportive network, but the uncertainty of outcomes for any individual subject implies that there is the capability for irrational dangers of antagonistic impacts.

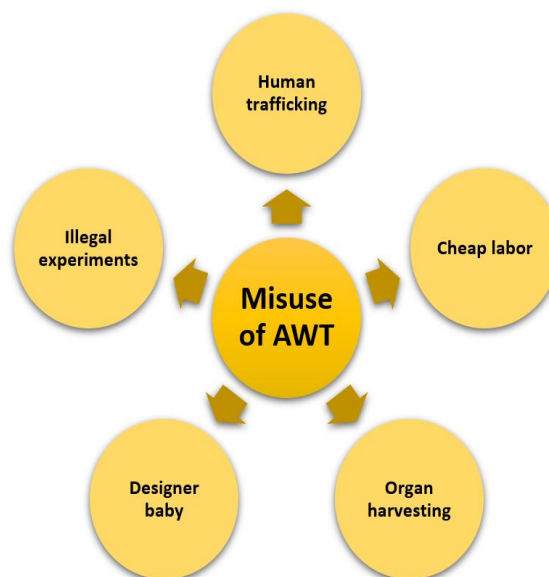


Figure 2 The diagram shows the probable misuse of Artificial Womb Technology (AWT). It highlights the five significant areas where AWT might be misused.

Therefore, to conclude, it is significant that we begin thinking about a portion of the ethico-legal issues inalienable to trial Artificial Womb innovation before they are considered a clinical choice.

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